09/927230

In the Claims

Claims 1-7, 9-35, 39-43, 45, 49-51, and 53 are pending in the application with claims 1, 24, 34, and 45 amended herein and claims 47 and 52 cancelled herein.

1. (currently amended) A deposition method comprising:

at a first temperature, contacting a substrate with a first precursor containing dichlorosilane and chemisorbing a first layer at least one monolayer thick over the substrate;

altering the first temperature by removing heat [[with]] by applying an electric current through a cold junction of two dissimilar conductors or doped semiconductors of a thermoelectric heat pump thermally connected to the substrate, transferring the current to a hot junction of the conductors or semiconductors, and dissipating heat from the hot junction to establish a second temperature ;

at the second temperature lower than the first temperature, contacting the first layer with a second precursor containing ammonia and chemisorbing a second layer at least one monolayer thick on the first layer; and

reacting the second layer with the first layer and forming a Si_3N_4 layer.

2. (previously presented) The deposition method of claim 1 wherein the reacting comprises heating the first layer and the second layer to a third temperature higher than the second temperature and first temperature.

3. (previously presented) The deposition method of claim 2 wherein heating the first layer and the second layer to a third temperature comprises adding heat with the thermoelectric heat pump.

4. (previously presented) The deposition method of claim 1 wherein the second temperature is the optimum chemisorption temperature for the second precursor.

5. (previously presented) The deposition method of claim 4 wherein the first temperature is the optimum chemisorption temperature for the first precursor.

6. (original) The deposition method of claim 1 wherein the second temperature is established before the contacting the first layer by initiating a flow of the second precursor.

7. (original) The deposition method of claim 1 wherein the second temperature is not established until during the contacting the first layer by providing a flow of the second precursor.

8. (canceled).

9. (original) The deposition method of claim 1 wherein the first temperature is at least about 5 °C different than the second temperature.

10. (original) The deposition method of claim 1 wherein the first temperature is at least about 50 °C different than the second temperature.

3. (previously presented) The deposition method of claim 2 wherein heating the first layer and the second layer to a third temperature comprises adding heat with the thermoelectric heat pump.

4. (previously presented) The deposition method of claim 1 wherein the second temperature is the optimum chemisorption temperature for the second precursor.

5. (previously presented) The deposition method of claim 4 wherein the first temperature is the optimum chemisorption temperature for the first precursor.

6. (original) The deposition method of claim 1 wherein the second temperature is established before the contacting the first layer by initiating a flow of the second precursor.

7. (original) The deposition method of claim 1 wherein the second temperature is not established until during the contacting the first layer by providing a flow of the second precursor.

8. (canceled).

9. (original) The deposition method of claim 1 wherein the first temperature is at least about 5 °C different than the second temperature.

10. (original) The deposition method of claim 1 wherein the first temperature is at least about 50 °C different than the second temperature.

11. (original) The deposition method of claim 1 wherein the first and second temperatures are those of at least a portion of the substrate.

12. (original) The deposition method of claim 1 wherein the first and second temperatures are those of an outermost surface of the substrate.

13. (original) The deposition method of claim 1 wherein the first and second temperatures are those of the precursors.

14. (original) The deposition method of claim 1 further comprising providing background heat.

15. (original) The deposition method of claim 14 wherein the background heat is provided at a fourth temperature between the first and second temperature.

16. (original) The deposition method of claim 14 wherein the background heat originates primarily from a heat source comprising a heat lamp array or a wafer chuck heater.

17. (original) The deposition method of claim 1 wherein the substrate comprises a bulk semiconductor wafer.

18. (previously presented) The deposition method of claim 1 wherein the first precursor consists of dichlorosilane and the second precursor consists of ammonia.

19. (original) The deposition method of claim 1 wherein the first and second layers each consist essentially of a monolayer.

20. (original) The deposition method of claim 1 wherein at least one of the first precursor and the second precursor comprise a plurality of different precursor species.

21. (original) The deposition method of claim 1 wherein the first and second precursors each consists essentially of a single precursor specie.

22. (original) The deposition method of claim 21 wherein the single precursor specie exhibits only one chemical structure.

23. (original) The deposition method of claim 1 further comprising purging the first precursor before contacting the first layer with the second precursor.

24. (currently amended) A deposition method comprising:

atomic layer depositing a first specie over a substrate approximately at an optimum temperature for the first specie deposition;

removing heat [[with]] by applying an electric current through a cold junction of two dissimilar conductors or doped semiconductors of a thermoelectric heat pump thermally connected to the substrate, transferring the current to a hot junction of the conductors or semiconductors, dissipating heat from the hot junction, and atomic layer depositing a second specie on the first specie approximately at an optimum temperature for the second specie deposition lower than the first specie optimum temperature; and

reacting the second specie with the first specie at an optimum temperature for the reaction greater than the second specie optimum temperature and first specie optimum temperature.

25. (original) The deposition method of claim 24 further comprising purging the first specie before depositing the second specie on the first specie.

26. (previously presented) The deposition method of claim 24 wherein the first specie is deposited from dichlorosilane, the second specie is deposited from ammonia, and the reacting produces Si_3N_4.

27. (original) The deposition method of claim 24 wherein a chemisorption product of the first and second species consists essentially of a monolayer of a deposition material.

28. (original) The deposition method of claim 24 wherein the first specie is different from the second specie.

29. (previously presented) The deposition method of claim 24 further comprising atomic layer depositing at least one additional specie along with deposition of the first specie and/or deposition of the second specie.

30. (previously presented) The deposition method of claim 24 wherein the first specie is an initial specie and is the same as the second specie.

31. (previously presented) The deposition method of claim 24 further comprising adding heat with the thermoelectric heat pump to obtain the optimum temperature for the reaction.

32. (original) The deposition method of claim 24 wherein the first and second specie optimum temperatures are those of at least a portion of the substrate.

33. (original) The deposition method of claim 24 further comprising purging the first specie before depositing the second specie on the first specie.

34. (currently amended) A deposition method comprising:

chemisorbing a first monolayer of a first compound over a substrate while maintaining the substrate at a first temperature with a heater;

removing heat ~~with~~ by applying an electric current through a cold junction of two dissimilar conductors or doped semiconductors of a device different from the heater, transferring the current to a hot junction of the conductors or semiconductors, and dissipating heat from the hot junction and establishing the substrate at a second temperature at least about 1°C lower than the first temperature, the device exhibiting a thermoelectric effect;

chemisorbing a monolayer of a second compound on the first monolayer of the first compound at the second substrate temperature;

adding heat with the device exhibiting a thermoelectric effect by reversing direction of the electric current through the cold junction, transferring the current to the hot junction, and collecting heat from the hot junction to establish the substrate at approximately the first temperature; and

chemisorbing a second monolayer of the first compound on the monolayer of the second compound.

35. (previously presented) The deposition method of claim 34 wherein the second substrate temperature is the optimum chemisorption temperature for the second compound.

36. (canceled).

37. (canceled).

38. (canceled).

39. (original) The deposition method of claim 34 wherein the second temperature is established before the chemisorbing the monolayer of the second compound.

40. (original) The deposition method of claim 34 wherein the second temperature is not established until during the chemisorbing the monolayer of the second compound.

41. (previously presented) The deposition method of claim 34 wherein the first monolayer is chemisorbed from dichlorosilane and the second monolayer is chemisorbed from ammonia.

42. (original) The deposition method of claim 34 further comprising purging any first compound not chemisorbed before chemisorbing the second compound.

43. (original) The deposition method of claim 34 wherein at least one of the first compound and the second compound is formed from a plurality of different precursor species.

44. (canceled).

45. (currently amended) A deposition method comprising:

chemisorbing a first monolayer of a first compound over a substrate while maintaining the substrate at a first temperature with a heater;

adding or removing heat [[with]] by applying an electric current through a cold junction of two dissimilar conductors or doped semiconductors of a device different from the heater, transferring the current to a hot junction of the conductors or semiconductors; and, respectively, collecting or dissipating heat from the hot junction, establishing the substrate at a second temperature at least about [[1]] 50°C different from the first temperature, the device exhibiting a thermoelectric effect;

after purging any first compound not chemisorbed, chemisorbing a monolayer of a second compound on the first monolayer of the first compound at the second substrate temperature;

adding heat to establish the substrate at a third temperature at least about 50 °C higher than the second temperature and reacting the chemisorbed second compound with the chemisorbed first compound;

adding or removing heat by applying the electric current through the cold junction, transferring the current to the hot junction, and, respectively, collecting or dissipating heat from the hot junction to establish the substrate at approximately the first temperature; and

chemisorbing a second monolayer of the first compound on the reacted layer of first and second compounds.

46. (cancelled).

47. (cancelled).

48. (cancelled).

49. (original) The deposition method of claim 45 wherein the third temperature is established after completing the chemisorbing the monolayer of the second compound.

50. (original) The deposition method of claim 45 wherein the third temperature is established during the chemisorbing the monolayer of the second compound.

51. (original) The deposition method of claim 45 wherein the first temperature is greater than the second temperature.

52. (cancelled).

53. (original) The deposition method of claim 45 wherein at least one of the first compound and the second compound is formed from a plurality of different precursor species.